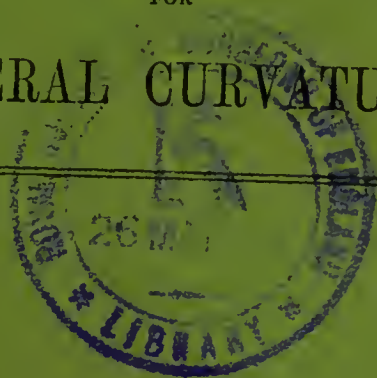


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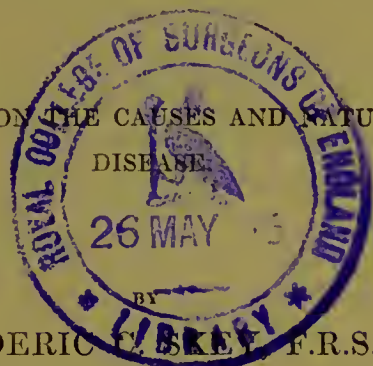


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ON
A NEW OPERATION
FOR THE CURE OF
LATERAL CURVATURE OF THE SPINE.

ON
A NEW OPERATION
FOR THE CURE OF
LATERAL CURVATURE
OF THE
SPINE:

WITH REMARKS ON THE CAUSES AND NATURE OF THAT
DISEASE.



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PREFACE.

A PRINCIPLE, long known for its utility in the cure of distortions, has been recently applied, with marked success, to the deformities of the spinal column. Great interest has been excited, as well in the public as the professional mind; the daily press having contributed its powerful aid in placing upon record several cases in which the most satisfactory results have been established. My name having appeared through this medium, in connexion with the mode of treatment referred to, I was persuaded to extract from it a hope that my views were not unworthy of being presented to the public. My attention has been directed for some years to the subject of lateral curvature, and I hope it may be added, without vanity, that great success has attended the application of the principles which this publication is designed to recommend. Besides this

incentive to communicate my opinions in print. I am influenced by a desire to explain, in a simple and distinct manner, the nature of the deformity—more especially those conditions of it in which alone the operation is justifiable,—and to warn against the too common practice of over-tasking a new remedy, without a due regard to the selection of appropriate cases. I would insist upon this point with much emphasis, as an error which cannot be too strongly deprecated, its effect being, that measures, of sterling value, in their proper sphere of action, to the good of mankind, are perverted to the production of most serious mischief.

Charter-House Square, December 1840.

ON LATERAL CURVATURE.

By the term lateral curvature of the spine we understand an abnormal deviation from the natural curve of that column, in a lateral direction. The same pathology will, however, equally apply to the inclination intermediate between that which is directed forwards, and the last mentioned, or true lateral curve. Although in reality oblique, this may be still entitled the lateral curve, as it is very desirable to retain one simple term that may be applicable to every morbid variety based on the same principle of diseased action. It is well known that the human spine is a column possessing various attributes or properties, and composed of alternate layers of bone and elastic cartilage. These properties are threefold :—1st, to afford a stable upright pillar for the head and trunk ;—2nd, to form a canal for the transmission of the spinal marrow ;—and 3rd, by its flexibility, to be susceptible of curvation in nearly all directions. These functions on first reflection would appear almost incompatible with each other ; but they are all admirably and beautifully blended, in this perfect piece of mechanism—which at the same

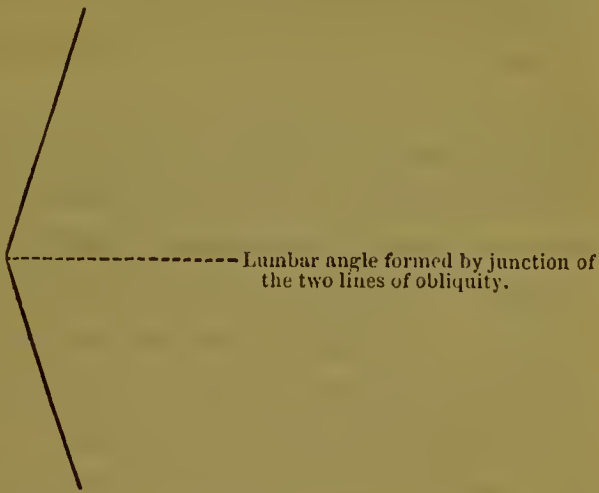
time, combines the stability of a column, with the mobility of a joint, and transmits through its bony tube the delicate substance of the spinal marrow. But its economy is liable to derangement. In the earlier periods of life the cartilaginous part of the column is soft and compressible, and readily yields to pressure continuously, or frequently, applied in one direction. By such means this structure loses its elasticity on the side of the pressure, where it continues flattened after the weight is removed ; and if the superincumbent weight be continued for any considerable period after the cartilages have lost their elasticity, these substances are more or less thinned by absorption, rendering the process of reparation protracted, if not uncertain. With a view to provide against the frequent occurrence of curvature from such simple causes, nature has placed the elastic spine under the controlling influence of two large muscular pillars, which bound it on each side, and by the antagonizing power of which, it is retained erect and firm. Their services, however, are more actively called into operation when the body is arched forwards ; as in bowing or bending, when by their conjoint action it is restored to its natural attitude : and when we look at the enormous leverage of the head and trunk when so bent forwards at a right angle on the legs, it is obvious that their magnitude is not superfluous. Curvature from undue compression

of the intervertebral substances or cartilages can indeed only occur in the lateral, or nearly the lateral direction, because it requires a duration of compression longer than the muscles could be retained in action. Curvature forwards would necessarily bring these muscles into active play, and they, when wearied—that is to say, in the course of a few minutes—would cease to make an effort, and either yield entirely, by which the body would be precipitated forwards, or would relieve themselves by drawing the weight of the body to the perpendicular line, an operation which when effected, would naturally and without muscular effort transmit it to the ground. Therefore as we cannot retain that forward position without muscular effort, which is susceptible of continuous action only during a brief period, so it follows, that permanent compression of the fronts of the intervertebral cartilages is impossible. Again, with respect to curvature backwards, the same argument will apply with still greater force; because as in that unnatural position the action of the large muscles of the spine is now represented by those on the front of the trunk, which are much smaller, so the effort must be greater, or, in other words, the duration of the posture shorter.

Lateral curvature, therefore, or distortion of the spine from undue compression of its cartilaginous structure, is by no means necessarily the product of muscular action, although it is very commonly

deemed so, and it still more rarely originates in muscular contraction, when it occupies its general seat in the loins, where it is situated, probably, in four cases of disease out of five. The lumbar region is by far the most mobile part of the spinal column, and it forms, as it were, a centre of motion to the whole body. So long as the head is neither inclined to the one side or the other, but retains its natural relation to the trunk, its weight, with that of the trunk, is conveyed in an equal degree by each leg to the ground, or in other words, the axis of gravitation occupies the mesial line of the whole body: but no sooner is the position of the head altered, by being carried towards either shoulder, than the lower extremity of the same side receives the additional weight of the head, extending over and beyond the axis, in a ratio increasing with the squares of the distances between the projecting head and the axis; and if the extension of the head to one side be accompanied by the chest also, then the weight is no longer supported by the two extremities, but by the one belonging to that side towards which the head is inclined, and the other leg is placed on the ground generally in a state of extension, for the purpose of enlarging the base, and adding steadiness to the position. In this attitude an angle is formed at the loins, at which the double lines of obliquity of the body meet: the upper line extending downwards from the head, and

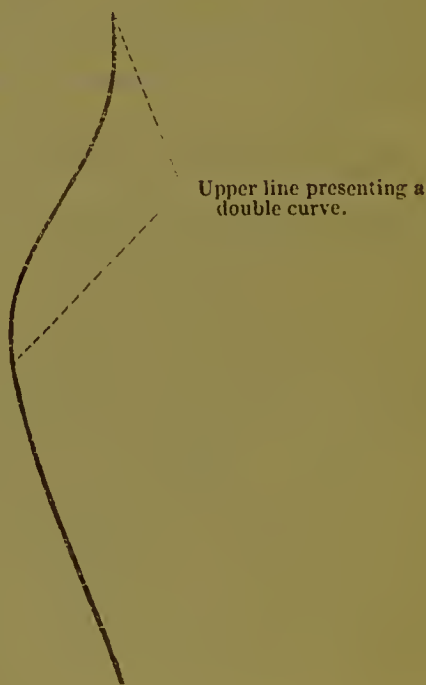
terminating in the lumbar vertebra; the second extending upwards from the foot, which supports the



weight of the body, reaching the loins by the same obliquity of direction. This position becoming permanent is all that is necessary to the ultimate completion of true lateral curvature.

These lines meet in the loins, and not higher up the spine—because the loins form, as has been already observed, the most extensible and mobile part of the column; and not in the dorsal region, because, for obvious reasons, nature has furnished this portion with a very limited extent of motion. Besides, had it been otherwise—had the extent of motion been rendered greater, it would have been inadequate to the purpose, from the shortness of the upper line, viz., from the dorsal region to the head, the obliquity of which would have been too sudden and too positive, to

give the head its natural and indispensable attitude of perpendicularity. Nature has given to the region of the loins the greater freedom of motion, *because* that portion of the body is midway between the head and feet, and thus the diverging lines of obliquity are more gradual, and the stability of the body, when placed in that attitude, is necessarily greater. But there exists an important distinction between the forms of these two lines of obliquity ; for whereas the lower one is straight, the upper line is bent into a gentle curve, for the purpose of enabling the head to be kept straight ; for it is only in very extreme cases of curvature that the head itself is inclined to one side.

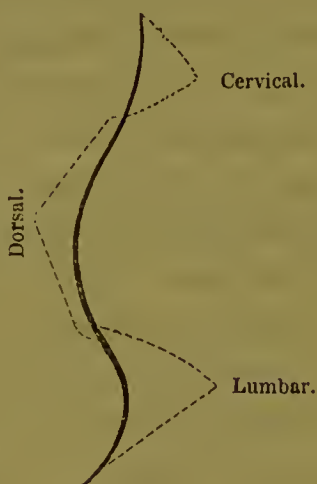


This double curve indicates a healthy state of the spinal column, and is immediately converted into a straight line when the weight is transferred in an equal degree to both legs.

The term a straight line, however, is applicable only to the full back view of the column, and, physiologically speaking, is subject to a yet farther exception, for there is always in health a slight projection of the middle third of the column to the right side, in a degree not however very perceptible to casual observation. This variation is probably due to the greater strength and activity, and more frequent employment of the right, than the left arm. This explanation appears to derive some confirmation from the nature of one form of disease of the spine, to which allusion will, hereafter, be made; viz. curvature from great muscular exertion of one arm.

The more striking natural deviation from the perpendicularity of the spinal column occurs in the antero-posterior direction, which is required for the economy of important organs to which it forms a partial boundary. This also consists in a projection of the middle or dorsal portion, producing a curve backwards of more than a third of the length of the whole column, and giving a roundness to the middle of the back perceptible when the shoulders are drawn forwards—an action

which serves to separate the scapulæ from each other. The necessary consequence of this projection backwards of the dorsal vertebræ is, that of the anterior curve in the upper or cervical, and that of the lower, or lumbar portions of the spinal column, on the principle previously explained in relation to the primary cause of lateral curvature, viz. to maintain an axis or centre of gravity.



Of these natural arches of the spine, one only is essential, and two are consequent. The essential curve is the middle or dorsal—that portion which bounds posteriorly the cavity of the chest; and we have no difficulty in attributing this projection backwards of the dorsal vertebræ to the functions of the heart and lungs which are situated within that cavity. By this curve, and the arches of the ribs, which are attached to it, a considerable part of the lungs is placed behind the column,

thus tending to antagonize a proportionate weight of those organs, placed in front. It is also auxiliary to a greater expansion of the lungs in the act of inspiration; for it should be observed, that the spinal pillar is formed by the conjoined bodies of the vertebræ, which are placed in front of the projecting ridge of the back to the extent of from two to three inches, along its whole length. By this configuration man alone is characterized, for man alone claims the erect posture as one of the many prerogatives that distinguish him from the inferior classes of the animal world.

Inasmuch, therefore, as an expanded chest is indispensable to the healthy action of the lungs, and to the purpose of affording breadth of space for the great vessels of the heart, so is the whole spine influenced by this one curve, of which the two others are essential consequences: viz. the flatness of the back of the neck, and the hollow cavity of the loins, by the combined projection forwards of which, the axis of gravity is again restored.

But the spine being composed of soft and yielding material, as well as bone, will assume any form that continued pressure may dictate: and it is not surprising, therefore, that we sometimes find in persons who have been long con-

fined to the horizontal position, by the use of a board or hard mattress, that these natural curves, or arches, so indispensable to health, are totally destroyed—the spine presenting one undeviating line from the head to the pelvis. Yet this was the system adopted so generally by our profession, till within a period of twenty years, for the cure of curvature, whether arising from disease of the bony fabric of the column, from lateral distortion arising from continued pressure of its cartilaginous structure, or in that numerous class of cases in which it was yet more reprehensible: viz. hysteric affections, simulating the form of approaching spinal disease. Among the latter class, it was by no means uncommon for young ladies, the peculiar subjects of this disposition, to be confined on the back for a period of many months or years, on an inclined plane of wood or unyielding mattress, by which such evils were engendered as would probably attend them throughout the remainder of life, viz. a real distortion from the natural form of the spine, atrophy of the muscles from the absence of healthy employment, and torpidity of the digestive functions from neglect of exercise.

We will now proceed to consider the cause of lateral curvature, both remote and immediate. It has been already remarked, that so long as the head is kept erect, in a healthy person, and the

weight transmitted in an equal degree by each leg to the ground, lateral curvature from undue compression of one or other side of the column is impossible ; but no sooner is the centre of gravity destroyed by the inclination of the head, or part of the body, to one side, than the flexion of the spine immediately occurs. So long as the alteration is due merely to occasional position, no harm is done, and the pillar recoils, or returns to its natural curve. But if the alteration of position be frequent, and abundant cause in every-day life may render it so, then an impression is made on the intervertebral elastic substance, and the recoil becomes imperfect. Should the cause be renewed, the evil increases, in the ratio of its force and continuity, till at length the temporary deviation from the natural form becomes a permanent one, and lateral curvature is the result.

But this change is not limited to one portion only of the column. *In a large proportion of cases the first effect is directed to the lower or lumbar portion of the spine*, because it is there that the two lines of obliquity meet, and, consequently, it is to that part that the influence of lateral weight is conveyed ; it is there only that the spine possesses sufficient mobility to afford compensation for its lateral pressure. This may, therefore, be considered the primary curve, and the direct cause of the succeeding, or dorsal ; for the dorsal

vertebræ are necessarily thrown out of position by any deviation from the line below them. Should the dorsal portion of the column retain its natural form under this altered position, the consequence would be, not only that the head would be directed to the side of the curvature, and extend considerably beyond the centre of gravitation, but the face would lean to one side in an oblique direction, and the transverse axis of vision would be destroyed. This would require so continuous an effort on the part of the opposite muscles of the whole body, as would be quite incompatible with more than a brief endurance of the upright posture; and nature has provided against it by giving to the muscles of the opposite side of the vertebræ, a tendency to draw the spine back, not however to its former line, but to such an extent beyond it, as may be required to compensate for the primary curve, and by which the equipoise of the body may be restored, without the necessity of continued muscular effort. Thus the whole distortion becomes *double* or *sigmoid*.

These two processes, although for the sake of description presented consecutively, are in reality contemporaneous in their progress; for inasmuch as the lumbar curve is the product of a slowly exerted and oft repeated deviation from the natural line, the two portions of the distortion advance together, *pari passu*—and will in general in this

form of curvature be found to hold a certain ratio to each other : of the two, the upper or dorsal curve is the more apparent, and is far more injurious to the symmetry of the body, because this region being intimately connected with the attachments of the ribs, any considerable deviation from their natural form manifests itself in change of that of the chest,—the structure of which suffers distortion in proportion to that of the spine, and the ribs on the concave side of the curve are as necessarily approximated, as those on the convex are separated from each other.

By the approximation of the ribs the attachments of the intercostal muscles of that side approach nearer to each other also, and become gradually impaired in size and in usefulness, till at length the ribs are in actual contact, and the muscles are absorbed, or converted into layers of a merely tendinous structure. The influence of this abnormal condition of the parietes of the cavity effects an important change on the lungs within it ; for as the chest can no longer expand, so the lung no longer admits the quantity of air, by the act of inspiration, which it claimed when in a condition of health, and the chest becomes flattened on the same side, as the result of the pressure of the ribs against each other. The position of the heart also is often altered in a remarkable degree. In considerable distortion of the dorsal vertebræ the

concavity of which is on the right, the apex of the organ is felt at the distance of four or five inches from the edge of the sternum ; while, in examples of concavity to the left, the pulsations of the whole of the heart are felt on the right side of the chest.

The change on the opposite or convex side of the curve is as remarkable ; for as by the leaning of the vertebræ towards the ribs these bones are brought nearer in contact, so the leaning of the vertebræ from the ribs as necessarily enlarges the intervals between them, and the lung on this side performs in a considerable degree the office of the two organs ; so that patients thus affected find it indispensable to free respiration to confine themselves to that position which admits of the freest play to the expanded half of the chest,—in other words, they can lie only on the side of the body corresponding with the flattened side of that cavity. The half of the chest corresponding to the convexity of the curve is, usually, in a more striking degree distorted from its natural form, than any part of the figure, for the ribs, instead of pursuing a curve resembling a capital C, are pressed outwards at their attachments at the vertebræ, and at the same time are dragged downwards by the action of the sacro-lumbalis, and by these means the angles of the ribs, or the points of their greatest posterior prominence, are drawn or

forced backwards in the form of a large mound or projection, which raises the bladebone at an angle on the ribs, and distorts in an essential degree the form of the whole chest. From this rounded prominence the ribs bend inwards, in a direct line towards the sternum in front, and give a necessarily flattened aspect to the chest in this direction ; and by which the breast in a female on the same side is drawn rather to the side of the body, and the symmetry between the two is destroyed.

It is not very easy to explain the principle on which this posterior projection of the ribs occurs, otherwise than as the result of the projection of the dorsal vertebræ, which must of necessity affect in a material degree the relation of the ribs to each other. The ribs on the concave side of the arch are brought nearly or quite in contact, while those on the convex are separated. But they are not only separated ; they are forced outwards, towards the side. For the same reason that a rib is more likely to be broken at the angle of the bone than at any other part, so will lateral pressure effect a corresponding change in this portion—a change by which the angle becomes more and more prominent ; while the shaft of the bone possessing a given length only, proceeds abruptly forwards to reach the sternum. Even on this side, the chest on this account is flattened ; partly by the unna-

tural convexity of the ribs behind; partly also due to the action of the abdominal muscles, in drawing the sternal extremities downwards. The deformity is increased by the presence of the scapula, which has to accommodate itself to the rounded prominence on which it rests, and by the projection of which, the deformity is rendered still more apparent.

It is very important, in the consideration of this subject, not to confound two very distinct causes of lateral curvature: one resulting from unequal pressure on the spinal column from above; the other, from continued muscular exercise. In the former the curve is more distinctly sigmoid or double; while in the latter, the product of muscular efforts, the distortion is in a marked degree more restricted to the middle or dorsal portion; which appears drawn out of the natural direction towards the unequally exercised limb. They may, generally, be distinguished at a glance by the condition of the muscles, which are prominent and rigid in those examples which are dependent on muscular effort, and are atrophied and relaxed in the more common forms of distortion, produced by unequal pressure from above. The former, moreover, occur in strong and healthy male subjects, the latter in women and children, or in young persons of both sexes, but chiefly females.

Among the immediate or proximate causes of

unequal pressure on the spinal column has been assigned, by some medical authorities, an unhealthy relaxation of the ligaments of the spine; but with no rational explanation: indeed, it is difficult, anatomically speaking, to explain this view on any satisfactory grounds; because, in truth, there are no lateral ligaments of the spine the relaxation of which would throw any light on the disease; and supposing nature had conferred on the column the advantage of such a structure, we have in pathology no analogous form of disease with which to compare it. The term, therefore, is rather employed in a general sense, to express a convenient uncertainty of its nature, than to uphold a doctrine which neither the researches of the anatomist, nor the known principles of diseased actions, will approve or warrant. At the same time, it is not unreasonable to suppose the intervertebral cartilages to have acquired in some occasional examples an unnatural degree of softness, by which they yield to the influence of lateral pressure at an earlier than average date of compression. But even allowing the possibility of this condition, some additional and positive cause of distortion must pre-exist, to which it must be more directly assigned. But this condition is accompanied by a more or less degenerate state of all the structures; such as bones, muscles, &c. We cannot doubt that under such circum-

stances, lateral curvature, from whatever cause, would advance rapidly.

The immediate causes of unequal pressure are, undoubtedly, such as to derange the uniformity of the spine by disturbing its equipoise. If a weight of a few pounds be placed on one shoulder of a child of ten years of age, and the shoulder be depressed with some force by the hand at the same moment, the opposite muscles are brought into palpable action ; but if the hand be removed, the contracting muscles, the sacro-lumbalis, longissimus dorsi, and the quadratus lumborum (the latter of which, however, is concealed from view), will immediately raise the opposite shoulder with its superincumbent weight, till it is well balanced on the spinal column, and the action then ceases, for the object of its action is accomplished, and the muscles of the two sides are, apparently, in a state of rest ; but not strictly so ; for the muscle belonging to the side which is *opposite* the weight continues in a state of vigilant observance of the position in which the body is drawn—not with a view to retain it in that position, because the weight is already balanced, but for the purpose of preventing any sudden displacement of the body. This kind of vigilant observation of their antagonists while in action is a common condition of all muscles. In other words, it is impossible to

effect the contraction of any system of muscles in the body without a permissive action on the part of their antagonists; so that all these powerful agents are under an especial control, by which their movements are subdued, and regulated. Were it not so, nature would have provided us with some agent less powerful in contraction than muscular fibre. This form of distortion, therefore, is not due to muscular effort, but to the simple continued pressure of the sides of the intervertebral structures. This kind of curvature exists in young women and children of any age. It is a passive, not an active state; the weight oppresses the column in a lateral direction, the column adapts itself to the weight, and the laterization becomes permanent.

The causes of lateral curvature of this, the more common form, viz. that from superincumbent weight unequally applied on the spinal column, are often obscure. But this very circumstance tends to explain its nature. From the existence of any habit, however natural and however trivial, tending to the frequent inclination of the body in one direction, in a degree not counterbalanced by that in the opposite, may be dated the first deviation from the healthy form of the spine.

This *premier pas* uncorrected, because undis-

covered, is possibly all that is required for the accomplishment of permanent distortion. Equipoise, so indispensable to muscular inaction, being once disturbed, muscular agency assumes a new character in the economy. One set of lumbar muscles is, from this period, superseded in its occupation, viz. that towards which the inclination has lent; and, in the same ratio, the duties of the opposite muscles are enhanced, to the effect of their development in a degree often approaching to that of double their original magnitude.

All this may progress to the entire destruction of symmetry, without an observable cause, unless some accidental opportunity be afforded to the attendant, by which the earliest approach of this distressing malady may be detected and averted. A sprained ankle—the slightest inequality in the actions and force of the two legs—the habit, when in early childhood, of nursing infants, both in reference to the nurse and child, so long as the habit is restricted to one arm—games at school, implicating the muscular effort of one leg or arm—an ill-made dress, slipping off one shoulder—badly-adjusted stays in young girls, which afford an unwarrantable artificial support, unequally applied;—these, and all such, are among the remote causes of lateral curvature of the passive kind.

Unequal power in the two legs is, of all causes, one of the most certain ; because, when at rest in the upright position, the weight is invariably thrown on the stronger limb, and the lumbar vertebræ bear early testimony to the obliquity of the form ; and that position, which was previously the result of convenience, now becomes that of necessity, and curvature is established. But all this may advance unconsciously to the parents of, or attendants on, the child, till, on discovery, the medical attendant on the family is consulted ; and even then, possibly, the dorsal curve, with its certain concomitant, the projection of the ribs, may claim his almost undivided attention, at the expense of the lumbar, which is the only key to the ultimate cure. It must be very obvious to any person, with a view of the bony skeleton before him, that, however potent may be the influence of the lumbar vertebræ in causing indirectly that extensive distortion of the ribs which is the most prominent feature in lateral curvature, yet that they cannot themselves exhibit a proportionate degree of deviation. It is not that the lumbar curve is less considerable because it is less apparent, but because the ribs form, as it were, lateral prolongations of the dorsal vertebræ, and diverge from each other like radii from a centre. It is because this region of the back presents the most marked degree of deformity,

that our medical energies are wasted on it, while the germ of the mischief continues unchecked.

A second form of lateral curvature is conjointly the effect of weight unhealthily applied, and of muscular effort. Such, for example, as would arise from the habit of raising or carrying a weight in one hand, as the remote cause. A boy, aged sixteen, was occupied for some part of each day in carrying a basket of clothes, which was swung between himself and his mother : he always employed the same arm, in consequence of disease in the elbow-joint of the other arm. The effect of such exercise as this, would be to distort the spine very effectually. When any considerable weight is raised from the ground, by the hand, and carried between two persons, the obvious tendency of the effort is to draw downwards, towards the object carried, the bodies of the persons carrying it. This is obviated by an inclination outwards, from the feet upwards in a slanting direction, of the whole person, and when the weight is very great, so great is the necessity of counterbalancing it, that the feet of the bearers are carried almost underneath it ; and more especially is this the case if the object be raised high off the ground. The nearer the legs of each person, and the arms engaged, approach to a parallel

line, the more direct is the transmission of the weight to the ground, and the lighter the burden. At the same time the whole trunk above the angle of the two lines of obliquity is thrown off to the side opposite to the weight, and the arm, acting by its great length as a lever, affords additional relief by being extended horizontally at its full length from the body.

The effect of this exercise on the boy in question was a double distortion. 1st, The lumbar vertebræ were arched from the basket; and 2dly, the dorsal were arched towards it. In this example the dorsal arch was in reality consecutive, and not exactly contemporaneous with the first or lumbar curve, because in the continued effort of carrying the weight, the head as well as the body was inclined from the object; and it was not until the boy was relieved from the burden, that the dorsal curve would commence. But all this was the product of muscular effort, exerted, as is evident, with a view to counterbalance a weight applied on one side of the body only. The case of a boy, now in St. Bartholomew's Hospital, is peculiar, inasmuch as it presents an example of great sigmoid curvature, the product of causes both active and passive.

George Chandler, aged 17, a chimney-sweeper,

was engaged from the years of his childhood in carrying a weight, consisting of some of the appurtenances of his trade, varying from ten to six pounds, on his left shoulder, possibly with a view to retain free action of the right arm. The immediate effect of such a weight has been already alluded to: the weighted shoulder was drawn towards the mesial line or centre of gravitation; that of the opposite side being depressed below its level. The spine became early distorted in the region in which invariably from such causes the influence of superincumbent weight must be felt, viz. the lumbar.

Thus far in the history of his case the condition was passive. The right mass of lumbar muscles raised the weight towards the centre, and continued mere observers of the result. After the boy had pursued this employment for many years he was engaged to carry a heavy basket about the town with his father, for the sale of fruit in the street. The father observed that the boy invariably employed the left arm for the occupation, and when desired to change the sides for their mutual relief, as invariably refused, finding that he was unequal to the effort; and well might he be so, for his body was already distorted by the long continuance of his former occupation. His spine was greatly inclined from the perpendicular to

the right side, and of course he was totally incapacitated for such an effort, except with the left arm.

This form of distortion is the result of weight of any kind or form, suspended from the side of the body by the arm, which either from its amount, or from its encroachment on the legs in progression, and on which the stability of the person depends, demands a muscular effort to compensate for its tendency to draw the body in the opposite direction. This observation will apply to any weighty object carried and supported by one arm, if that side only of the body be continuously employed. Much, however, depends on the form and size of the object. A weight of twenty pounds in a plate of metal carried with its flat surface close to the leg, would incline the body in a much less considerable degree than a rounded object of the same weight, such as a pail of water ; because, on the principle previously adverted to, the nearer the arm with its appended weight form a line parallel to the adjoining leg, the lighter the burden, or, in other words, the more closely does it hang to the centre of gravity.

But we find one form of lateral curvature dependent on muscular effort, and on that only. It is found prevalent among artisans, and confined, from obvious circumstances, to males ; and of

these only the young, rarely appearing at a later age than about twenty-five or twenty-eight. It is produced by violent and continued muscular exertion required in pulling, and is frequent among printers, and others engaged in similar occupations. These examples are furnished from that branch of the trade which consists in working at the press—a duty that commonly devolves on young men, under the age above mentioned. This instrument requires great muscular power and continuous exertion. It is worked by means of a pole or bar, which is drawn forcibly backwards by the right hand, the left being engaged in steadying the body against the press. The muscular agents which are employed, are those muscles that retract the scapula in the direction of the spine, namely, the two rhomboidei, the levator scapulæ, the trapezius, and latissimus dorsi. Nearly all these muscles arise from the spinous processes of the vertebræ, which, by long traction, yield to the effort, and arch the dorsal portion of the column towards the limb. Of these we see various examples, the characteristics of which are, an inconsiderable lumbar curve, great muscular development, and distortion of the chest proportionate to the dorsal curve, and often very great. But the examples of this form of curvature are confined to one class of persons, and very rarely include females, or, indeed, males occupying a respectable station in life.

Many forms of curvature, especially those now under consideration, from great muscular exertion, present on examination some deceptive characters well worthy of attention. In the curvature from superincumbent weight, whether by the body itself, or by any artificial addition, the muscles of the loins are rather reduced than otherwise within their natural proportions, because the weight having been equalized at the expense of the natural form of the column while at rest, the muscles have nothing to do but to accommodate themselves to the change. But when the curve is primarily and principally dorsal, then the compensation in weight by the formation of an opposite curve is made by muscular contraction ; and the muscles on the *convex* side of the curve in the loins are enlarged or hypertrophied in their whole extent as high as the dorsal curve. This, however, is *an effect, and not a cause* ; for as the weight of the trunk is dragged from the centre of gravity by the projection of the dorsal curve, so the muscles which are opposed to it, become necessarily larger, in virtue of their increased duty. When the trunk under such circumstances is forcibly raised by the hands, the mass of muscles on the convex side rises most prominently on the surface, and the disparity of the two muscular columns becomes immediately apparent. The same remark will apply to the upper part of the same mass which is opposite the superior curve on

its convex side, although, being covered with the trapezius and latissimus dorsi muscles, it is not so apparent.

It is absurd to suppose that these muscles could have pushed the spine towards the opposite side, while it is equally obvious that their duties are increased in proportion to the increased weight of the trunk now leaning from the mesial line, and that they have accommodated themselves to them : it is so plausible, on examining a distortion of the back, to point to the enormous masses of muscle which occasionally skirt the ridge of the spinal column, as the cause of the disease. We know the lateral movements of the column to depend on them in health. We observe a deviation from its natural form. We observe also the unnatural condition of the attendant muscular pillars occupying the convex side of the curvature, and the immediate inference is — here, in the enlarged muscles, is the cause of the whole mischief. The error is both mechanical and physiological—mechanically the deduction is wrong, because the centre of gravity goes with the curve, and to exist in the relation of a cause the muscles must necessarily be placed within it, or on the concave side. Physiologically it is erroneous, because muscles have no active power of relaxation ; and the only mode by which a muscle can become enlarged and strengthened is by giving it extra duty. This is

the case of the muscles in question. Remove the cause, replace the spine in its normal or healthy attitude of perpendicularity, their occupation is gone, and their natural dimensions are restored. So certain as we observe a great disparity in the size of the long muscles of the spine, with almost the same certainty may we look for the cause on the opposite one; or, if not the cause, at least the seat. The attempt to relieve this form of disease by the division of these masses would be worse than futile, because it would tend to increase the evil it was intended to remedy. Should such an experiment be attempted, the result would be to frustrate nature's most beneficent and wholesome endeavours to maintain the healthy form and attitude of the body, and to enhance the deformity by paralysing the only agents that prevent its increase, strengthened by nature's own hand for the purpose. It is very true that when rendered tense, the muscles rise into firm and rigid pillars, and unreflectingly the thought might suggest itself, that by their division the spine might be raised yet more erect, and become more extended. But what will be the condition of our patient when this protective agent is removed? We shall too readily find that the chief antagonizing power of the real agents of the disease is sacrificed, and the distortion will increase in a compound ratio.

In all forms of curvature involving the lumbar

portion of the spine—and how rarely it is not implicated may be determined by its important function—we must look to that as the chief precursor and frequent cause of the rest of the deformity, be it active or be it passive. Lumbar curvature exists in the relation of a cause, when arising from the influence of lateral weights ; and it is then active. In the first and third forms of curvature it exists in the relation, first, of an effect ; and, secondly, of a passive cause of deformity. But these remarks will apply only to the muscles of the concave side, where they are diminished both in bulk and in length ; in bulk, because their services have been suspended ; and in length, because their attachments have been approximated by the laterization of the spine, and the muscles have acquired a new and a shorter sphere of action, which any muscle in the body would acquire under similar circumstances.

If in a case of compound fracture of the arm a portion of the bone, to the extent of an inch, were removed, what would be the condition of the muscles of the limb at the expiration of one or two years, after each muscle had shrunk to the extent of one inch of its former proportions ? Undoubtedly each muscle would be restored to the same, or nearly the same, condition of healthy action it possessed up to the period of the injury ; because all would have acquired a shorter

sphere of action due to the necessities of the limb ; and in like manner, though not in an equal degree, perhaps, do muscles accommodate themselves to increased length, as we find in cases of unreduced dislocation. The same principle must apply to the longissimus dorsi and sacro-lumbalis, after long approximation of their attachments into the ribs, and transverse processes of the dorsal vertebræ. They are abridged of their natural length ; they are no longer susceptible of extension ; and thus they become the passive causes of the lumbar curve.

But, in order to appreciate the especial efficiency of these two muscles to confirm the injury done, we must examine their structure, and we shall at once comprehend the difficulty of treating lateral curvature, so long as they retain their integrity, even in their reduced condition. Muscular fibre will, as above remarked, reconcile itself to any moderate alteration in the length of its attachments ; but not so tendinous structure, which is essentially inelastic and unyielding. We probably can, by the continued application of force, elongate muscular fibre ; but by far the more resisting material is tendon, which is rarely torn asunder, even by the most powerful external agents.

When we examine the nature of these passive

causes of lateral curvature, we find them especially tendinous in structure; not, indeed, like other muscles, in which the muscular fibre terminates abruptly in tendon which represents the muscle to its insertion, but we have here a layer of tendinous substance of considerable thickness spread over the surface of the muscle, and into this tendon the muscular fibres are largely inserted. This structure, in a somewhat modified degree, pervades most muscles of the body that are the subjects of long-continued exertion; but it predominates in a striking degree in the muscles of the loins.

The effect of paralysing the action of a muscle for a considerable time is that of lessening its bulk, and it becomes atrophied. The effect on these muscles will be the same, *quoad* the muscular fibre, while the tendinous matter with which the surface is invested will diminish in a far more limited degree, if it diminish at all, and its action on the points of its attachment will be reduced to little more than a tendon or mere cord. This, then, is the agent, not, indeed, by which the disease has been produced, but certainly that which produces the greatest obstacle to the cure. Divide this cord, and the loins become straight in an exceedingly short period of time; and as the loins present in the large majority of examples of disease, the first indication of its presence, and the direct and certain cause of the upper curvature, so

is it that the successful treatment of the lumbar, occupies the direct path to the cure of the remaining part. But the question is, what is anatomically the precise nature of the entire structure by which the curve is retained, in the lumbar region? Is it by the muscle itself, or by the tendinous layer that invests it? Undoubtedly the latter. Divide the surface only, and the muscle becomes sufficiently extensible to change the curve to a straight line. Disunite the sinewy band that forms the string to the bow, and the opposite muscle will compel the remainder to conform to the attitude nature herself has dictated, and, having effected this, it will itself resume the form and dimensions which the existence of a morbid necessity has required of it*.

The division of this obstacle is scarcely entitled to the name of an operation in surgery. It is effected by a pointed and nearly straight bistoury,

* In some cases the tension of the longissimus dorsi on the concave side of the lumbar vertebræ is not considerable, when the body is raised in any, even the greatest degree. This is probably due to the greater shortening of the quadratus than of the posterior lumbar muscles as the preventive obstacle to extension. By inquiring into a large number of cases, we might ascertain that this peculiarity was referable to the description of cause to which the curvature was primarily attributable. I am the more inclined to this opinion because I have observed this condition of the muscles in several examples of lateral curvature caused in young girls from carrying infants.

which is introduced from the outer side of the muscular pillar, across its external or cutaneous surface, and with which the surface only of the muscle need be divided. The depth of incision required is not more than the quarter of an inch, and the orifice no larger than just sufficient to introduce the instrument, perhaps a quarter or a sixth of an inch. The division may be effected in a few seconds of time. The section of the whole substance is not essential to the end required, for reasons already given.

By this simple division all is obtained that the operation will effect, viz. an open path for further treatment by the instantaneous removal of the greatest obstacle to the successful application of other, and efficient, remedial measures. Remove the lumbar curve, and the necessity for the dorsal one no longer exists. It is very true that it will continue to exist for a time, even in recent cases, and that it will require very positive and persevering treatment; but the cause is removed, and the effect may in some degree be removed also, even in the more chronic cases of distortion.

To attempt to remedy a dorsal curve, to the formation of which the lumbar vertebræ have greatly contributed, would prove as futile as the endeavour by an architect to raise a straight pillar on a leaning foundation. The dorsal curve is the

essential and natural result of the lower deviation, and, should the endeavour to remedy the dorsal curve be attended with success, this favourable result would prove inadequate to a final cure.

It is difficult enough to make head against disease, when the curative processes are in unison with nature's own indications. It is infinitely more so, when this harmony is disturbed by the attempt to struggle against an organic change in the structure of the body, established for the express purpose of compensation for a previous malady. On a like principle is the suggestion that would seek to remedy the effects of a lateral distortion of the dorsal vertebræ, after the lumbar curve had been removed, by means of a weight placed on the opposite shoulder to that which had formerly borne it; because, as the superincumbent weight on one shoulder had produced a primary curvature of the lumbar vertebræ, of which the dorsal was but the effect, so, to remedy the only remaining dorsal curve, it would become necessary to establish the lumbar curve in the opposite direction; for a superincumbent lateral weight can only cause distortion of the dorsal through the medium of that of the lumbar vertebræ.

In forming a judgment of the applicability of the operation for division of the lumbar muscles, or their tendinous surface, we must duly consider,

first, the class of cases ; and, second, the degree of disease in which it is admissible.

1. Negatively it is, it may be presumed, inadmissible in any form of congenital distortion, in which all the structures, muscles, bones, tendons, are moulded into one consentaneous form.

2. It is inadvisable in most cases of lateral curvature, due to hereditary liability, for here the tendency to the disease exists as in the above examples, although at a later date.

3. It is inadmissible in all cases in which the bones are in any degree the seat of disease, because unless the spinal column retain its pliancy, no good can be effected, and the division of the muscles removes an important vicarious agent of support.

4. Its advantages are very questionable in cases of very protracted disease, in persons advanced towards the middle period of life.

5. As we judge in cases of *talipes* of the advantages to be derived from division of a tendon by the degree of its tension, so in this form we are not justified in resorting to the use of the knife, if, on raising the trunk to its fullest extent, the muscles do not indicate some degree of tension.

On the other hand, it is applicable to cases of lumbar distortion, in which that portion of the column is susceptible of temporary extension by the hands. I do not assert that it will confer equal benefit on all cases, because much must depend on the age of the patient, and on the degree of the curve.

The most frequent examples are found in young ladies from twelve to eighteen years of age, in whose persons it is independent of muscular effort. If in these examples the back be raised by the hands with some force, the smaller mass of muscles on the concave side of the lumbar curve will become apparent, unless the subject of the disease exhibit a tendency to *embonpoint*. Here the division is advisable, in consequence of the passive contraction of the muscles on the concave side of the curve, for this form invariably commences in the lumbar portion, though it is not constantly so palpable as might be expected from the great extent of the dorsal distortion. I have divided several examples of this kind, and with promise of great ulterior success.

One example I have recently had in the person of a young girl named Eliza Swain, aged fourteen years and a half, who had been under my care for three months, and whose case resisted the most industrious efforts, both of myself and of her parents,

who were most solicitous of her recovery. The division of the tendinous surface of the muscles immediately removed the obstacle, and she is now progressing rapidly.

In the case of a girl aged seventeen, named Truby, which from its great extent promised little advantage from the treatment in daily use, we have now great promise of amendment from a similar form of division, though probably not of cure.

The division is applicable in cases occurring next in order of frequency, viz. those produced by lateral weight supported by the arm, or on the shoulder, in which the curve is the result of a more active contraction of these muscles than in the former examples. But if the necessities of the individual demand the continuance of his former occupation, it would be far better to leave the muscles intact, because their condition can scarcely be said to reach the level of positive disease, and they are indispensable to the forced and unnatural attitude his duties require. But in all probability, by the great implication of the dorsal vertebræ, the corresponding ribs will, by their pressure on the opposite lung, and by the displacement of the heart, have made considerable encroachments on his health, and he may be compelled to relinquish his injurious employment

for the sake of retaining his strength, if not his life. Under these circumstances only, is the operation warrantable. If the distortion have not proceeded to an extreme degree, the division of the lumbar muscles will remove the curve, and by the combined agency of the operation, and the suspension of the exciting cause, these examples will progress with even more activity than the former.

To this class belongs the case of the boy, George Chandler, who is advancing under very simple treatment most satisfactorily. In this boy I divided a fortnight since the greater portion of the muscular pillar. The outer wound had entirely healed within twenty-four hours, and within one week the lumbar curve had ceased to exist, so long as he was restricted to the horizontal position, and was very inconsiderable in the vertical one. The dorsal prominence of the ribs is yet large, but distinctly diminishing.

In the third form of disease, which is more rare, the operation is also subsidiary, and will afford little or no advantage so long as the cause is persisted in ; for here also recovery is only purchaseable on the condition of entire desistence from the kind of occupation which has produced it. Here the disease first manifests itself in the dorsal vertebræ, and the lumbar curve exists in

the relation of an effect only, but an effect as essential to the first departure from perpendicularity, as the dorsal curve follows the lumbar in the two former classes. In the early stage of this form of curvature, the operation on the lumbar muscles is inadmissible, because the disease exists in the lumbar vertebræ in the relation of an effect only. The only division that can be applicable is that of the longissimus dorsi of the affected or dorsal region, and the entire change of employment. In the latter stages, when the disease is confirmed, then the lumbar curve, at the bottom of the pillar, is too important to escape observation, and even division.

But wherever the division is made, it is unnecessary to extend it deeply : all that is requisite in the lower part of the muscle is to divide the surface freely to the depth perhaps of one-third of an inch, while above, in the dorsal region, the ribs and vertebræ would prevent more than a section of moderate depth. After the operation, I am in the habit of applying a compress over the divided muscle, which arrests the hæmorrhage, and at the same time keeps asunder the surface of the inner wound. The patient may be placed on the back, with the shoulders a good deal raised, and be left undisturbed during four or five days, or even a week, when the local symptoms will have subsided. Passive pressure should then be resorted

to, in the form of bandages drawing laterally, with a compress applied on the projecting ribs, fixed into uprights fastened to the side of the bed, with a view to remove the pressure from off the chest. At the termination of a fortnight in all probability the lumbar curve will have greatly disappeared, and in a month the treatment of the greater deformity may commence.

This will consist, after the fullest consideration of the primary causes of the curvature, and of all the structures involved, of means both active and passive.

The spine may be compressed by continued force into a straight line, but it will not be so retained in the vertical position of the body. Two objects are to be kept constantly in view : 1st, The mechanical replacement of the spine ; and 2dly, The invigoration of the muscular agents by which it may be retained. Each of these objects is indispensable.

Muscular activity of the dorsal agents of spinal motion will never replace a crooked spine : they must be invigorated by exercise while the spine is erect : and thus it is that the means are both mechanical and physiological.

A late somewhat notorious member of our

profession resorted to the former means, viz. the mechanical, almost exclusively, and great were the results, or rather apparently great; for we have to study the effects of remedial means applied in two attitudes of the body—the horizontal and the vertical. To what end is restoration of the perpendicularity of the spine, if it retain not its improved form and relation, in the vertical position. Such means as extension, pressure, &c., may possibly effect a very salutary alteration of the morbid distortion of the spine, but they do not cure it. As regards the recumbent position the change produced may be in appearance all that is requisite; but no sooner is the spine rendered erect, than the distortion returns in all its deformity.

The two forms or principles of treatment must be contemporaneously applied: 1st, The mechanical; and 2dly, The physiological. The mechanical consist in pressure and extension, of which each individual case will demand its own peculiar application. Pressure is an important agent, and it may often be effected by means of mere recumbency. Supposing the distortion to be placed very far round towards the spine, the principle of the application consists in pressure so applied as to influence the distortion only, and to leave untouched the entire remainder of the ribs, so that the intercostal agents of respiration

may remain unmolested. For the purpose of applying this pressure we must examine the fixed points of the trunk, with a view to select such as will form a substantial and unmoveable groundwork for its application, because there is no reason why the use of this important agent should be restricted to the recumbent position; otherwise we might content ourselves with apparatus attached to the sofa or bedstead on which the patient lies: but this is not sufficient for the principle of treatment, and of course not to the end: 1st, The spine itself offers sufficient resistance to warrant its implication as a fixed point, provided the application of the means be sufficiently extensive and not confined to a portion; 2dly, The sternum will bear great pressure in the adult without injury to the chest; for however great the distortion, the displacement of that bone is always very inconsiderable. But here also the pressure should be extensive, and not limited to a part. Moreover, the higher the pressure the less objectionable, because the lower part of the bone is supported on the elastic cartilages of the ribs, while the upper end being connected by the first ribs, which are short, and motionless, to the spine, is, on this account, more applicable for the purpose:—3dly, We have the pelvis, which presents a strong inelastic base for the application of the agents of pressure, from which various forms of springs may be raised, surmounted with pads, adjusted to

the form of the projection :—and, 4thly, We have the two axillæ, in which we can reach without difficulty the second ribs, which are little less mobile than the first. We may avail ourselves of any, or of all these situations, without incurring the danger of restricting the actions of the intercostal muscles, the healthy regeneration of which, in the flattened part of the chest, is so indispensable to success. We must always recollect that each rib has the form, attachment, and action of the handle of a bucket; that the chest, through the agency of the intercostal muscles, dilates in its transverse diameter, as well as in the vertical, by the diaphragm, and that lateral compression of the chest is quite incompatible with its healthy functions. In the application of pressure we must consider this construction, and sedulously avoid the resort to any means which tend to limit the extent of the chest, in this direction. In the majority of examples of lateral curvature both sides of the cavity are more or less flattened; that towards which the ribs incline, in virtue of their proximity, and by their great inclination downwards, they often approach the level of the brim of the pelvis, and occasionally descend below it. Those on the opposite side are distorted, consequent, as I have previously endeavoured to explain, on the dorsal projection. To restore both sides of the chest to their natural relations, and the lungs and heart within the cavity to their normal form and

position, is the object of the treatment ; and any directly lateral pressure would be fatal to these objects. Extension or elongation of the body by means of weights applied to the feet will afford but a moderate aid ; but there can be no objection to its occasional use, should it not be attended with pain. Among other mechanical means the recumbent position should not be neglected, as the best mode of relieving the intervertebral substances generally, and of confirming the advantage obtained by other means, whether mechanical or otherwise. I apply the term physiological to the other class of agents, because they consist in the attempt to regenerate and strengthen the natural agents of the body employed in retaining the normal attitude of erection : these are the muscles. Acting on the spine we have the longissimus dorsi and sacro-lumbalis, the latissimus and the trapezius, the two rhomboidei, and lastly, the quadratus lumborum : of these the more important are the longissimus dorsi, with the sacro-lumbalis and the quadratus ; but the active exercise of none of these is indispensable, for the longissimus is already divided, and its baneful tendencies are arrested on the one side, while the unnatural magnitude of the opposite should rather be reduced by inaction. The latissimus dorsi and trapezius are the property of the arm, and except in cases of primary dorsal curvature, from excessive action of one arm, no great advantage can be

acquired from their active employment ; still the use of such agents may be resorted to with some profit, which require muscular force in drawing the arm backwards and upwards from the extended position towards the trunk, by which the trapezius, and latissimus dorsi, and rhomboidei, will be brought into action, as we judge from the liability of disease from this cause, in persons engaged for many hours during the day in drawing objects towards them with great force. But the muscles which demand our especial care are the primary and secondary agents of respiration, for unless we can remodel these we shall accomplish very little by any efforts we may make to restore the healthy form and attributes of the chest. The chest requires expansion on one side, and remoulding on the other. We possess no means by which to dilate the cavity, excepting through the agency of its own powers ; nature may effect this salutary change, but the art of the surgeon, directly applied, can do nothing. We can press the chest inwards in any degree, but can we extend its dimensions in the opposite direction ? Certainly not. Still we have great power that may be indirectly applied, the most efficient, indeed, that we possess in the entire treatment, and this consists in a partial suspension of all agents tending to contract the chest, and throwing on the agents of dilatation the almost entire responsibility of the functions of

respiration. These agents are the diaphragm and intercostal muscles, the serratus magnus, and abdominal muscles. Of these, the intercostals alone dilate the chest, while all the remaining muscles tend to contract it; therefore we look to the intercostals as our chief resource; we repose on them the task of dilatation, protecting them at the same time against molestation, or interference. A weight, regulated by the sensibilities of the individual, should be applied on the abdomen, and bound down with some force, for the purpose of controlling the action of the diaphragm, hitherto the only agent of respiration. Under the application of moderate force, this large muscle will be restricted in its action, of which evidence may be obtained by simple pressure on the abdomen with the hand, when the chest will be seen to dilate in the transverse direction. The ribs begin gradually to rise in inspiration, and aided by the artificial pressure on the projecting ribs, they will, by perseverance, exert an influence on the form of the chest which is often surprising. The heart, which has been displaced, and the pulsation of which has long been audible to the right side of the sternum, in dorsal curvature to the left, will return to its natural situation, and the lungs will resume the form corresponding with the increasing rotundity of the chest. Towards effecting this object, however, we must also reduce the influence of the abdominal muscles,

as well as of the serratus magnus ; yet the latter muscle, on reversing its action, by withdrawing the scapulæ towards the spine, may be rendered a useful co-operating agent in the dilatation of the chest. But it is on the intercostal muscles that we must concentrate our most important efforts ; and these united efforts, steadily and unremittingly applied, will accomplish much, and, in very many examples, an entire removal of the disease.

While it must be acknowledged that the operation by which an important obstacle to ulterior treatment is removed is a valuable contribution to modern surgery, yet a host of circumstances will demand from us the greatest circumspection in its application. It is to be considered in the relation of the precursor only, of treatment—the means by which remedies may be efficiently employed for the reduction of the real deformity, and not the treatment itself.

An indiscriminate resort to the knife in all cases of curvature would quickly bring upon it the most merited obloquy, and create a distrust of its real merit by many who would derive advantage from its adoption. But the evil does not stop here. The peculiar anxiety and distress incidental to those who are the subjects of personal deformity, is rather aggravated than

diminished by the undisturbed condition of the general health. By continued physical suffering the mind becomes reconciled to deprivation, and the pleasures and amusements of society are relinquished without regret. New associations are formed by the abandonment of hope, and the occupations themselves become insulated and unsocial.

But a young woman, in the pride of youth and of beauty, possessed of every attribute that would inspire regard or claim sympathy, with mental powers highly developed, gifted with sensibilities painfully acute, but most especially sensitive to that beauty of form which contrasts so painfully with her own deformity—these are the subjects who will cling to hope while a glimmer of its reality remains, to point to the future prospect of a possible relief. And is it not in these cases that it behoves us to exercise the greatest caution how we picture a future that can never be attained—how we indulge a hope that art cannot realize? That the section of the muscles can effect much, I have too many and conclusive examples of disease now under my hand to entertain a doubt; but where I would operate on one case, I would decline it in two.

There is a peculiar proneness from these circumstances, in young patients afflicted with spinal

deformities, to cling to hope of relief, however slight, and ready consent and even solicitation are not wanting to add their influence to the wavering decision of the operator. It is not on the score of pain, still less of danger, that these remarks appear to me called for, but with the view, first, to obviate the pain of disappointed expectation to minds already depressed by misfortune ; and, secondly, from the earnest desire to claim, on behalf of a new and valuable remedial measure, the full tribute of justice for its merits, and, at the same time, to add my warning protest against its indiscriminate adoption.